Rootstocks

Choosing a rootstock is one of the most important decisions when planning an intensive pear production system. Rootstocks play an integral role in influencing tree vigour, growth habit, cropping, resistance to pest and diseases, and tolerance to unfavourable conditions in the growing environment.

The performance of a rootstock is influenced by a combination of factors including the choice of scion variety, the quality of rootstock material, grower management practices and the growing environment. It is therefore important that growers have a good understanding of each of these factors as well as rootstock characteristics to ensure they choose a combination that provides maximum yield efficiency.

Rootstocks for intensive pear production

Most European pear (*Pyrus communis*) cultivars are grafted on either clonal (vegetatively propagated) or seedling rootstocks of genus *Pyrus* (*P. communis, P. calleryana, P. pyrifolia, P. betulaefolia*) or on quince (*Cydonia oblonga*).

In the case of intensive production systems, the objective is to use a rootstock that restricts tree vigour, induces early cropping (i.e. is precocious) and results in a high yield efficiency. Yield efficiency is usually measured as yield per unit of tree size (trunk cross-sectional area).

Pear (*Pyrus*) rootstocks

Whilst quince is the preferred rootstock in Europe, *Pyrus* species rootstocks are still heavily used elsewhere, including Australia. The growing conditions for quince rootstocks in Australia are unsuitable e.g. drought, low pH soils. Most *Pyrus* rootstocks used are seedlings but these often generate vigorous growth from the scion/shoot system, a highly undesirable trait for intensive production. Not surprisingly, trees grown on seedling rootstocks can also be highly variable.

In Australia, *Pyrus calleryana* D6 seedlings are the most commonly used rootstock for commercial pear production. However, D6 is slow bearing and excessively vigorous - producing very large trees that are unsuitable for intensive pear production.

There have been some *Pyrus* rootstock selections developed for intensive production that are clonally (i.e. asexually or vegetatively) multiplied for commercial use; these are outlined below.

OHF series

The Old Home x Farmingdale (OHF) series of rootstocks originated in the United States. OHF 40, 51, 69, 87, 217, 282 and 333 are the major rootstock selections in this series. Overseas evaluations have shown a range of vigour and yield efficiencies. It is generally accepted that these rootstocks are too vigorous for intensive production. Some OHF rootstocks have been introduced into Australia, however no rigorous evaluation has occurred and they are not readily available from nurseries.

The Horner series of rootstocks are developed from crosses of OHF rootstocks. Trials are underway at the Mid-Columbia Agricultural Research and Extension Center in the US to screen for a dwarfing rootstock from this series.

BP1

BP1 originated in South Africa and is reported to have vigour similar to Quince A and BA29 (ie. 75% of *Pyrus calleryana*) and good yield efficiency. There are no reported compatibility issues between BP series rootstocks and scion cultivars. However, BP1 is highly susceptible to pear decline and fireblight and is difficult to propagate. Susceptibility to pear decline haslimited use of BP1 as a rootstock in Europe. In South Africa new blushed pear cultivars are now more commonly grafted on quince rootstocks than BP1 because these deliver smaller trees, higher yields and fruit with better colour and higher TSS.

Rootstock BP1 is currently being evaluated in the Australian Pome Fruit Improvement Program® Ltd. (APFIP) pear rootstock trial in the Goulburn Valley. It has shown reduced vigour and improved yield efficiency compared with D6 for both Williams and Packhams. BP1 is commercially available in Australia but numbers can be limited. Results from the trial can be found by visiting the APFIP website.

Figure 1: Williams on BP1 in its 5th leaf at the APFIP pear rootstock trial in the Goulburn Valley. Central leader system with plant spacing of 4.5 m x 1.4 m (1,585 trees/ha)

Pyrodwarf

Pyrodwarf originated from a cross between Old Home and Bonne Luise d'Avranches. It reportedly has 50 % lower vigour than D6 and good graft compatibility with European and some East-Asian pear varieties. Pyrodwarf has low susceptibility to iron chlorosis, is tolerant to water-logging and is winter hardy. However, evaluations in Europe suggest it is still too vigorous for intensive systems.

Pyrodwarf has been introduced to Australia and is included in the APFIP® pear rootstock trial. This should yield valuable information about its performance under local conditions.

Pyriam

Pyriam is a clonal rootstock developed by INRA in France through open pollination of Old Home. It has not been tested in Australia. It is seen as a potential replacement for Quince BA29 in south-east France. It reportedly has good graft compatibility with Williams, is easily propagated, has a low susceptibility to fireblight and good growth and habit in the nursery. Pyriam induces slightly higher vigour than BA29 but has equal productivity and fruit sizes. No published data is available to compare its performance to quince.

BM2000

BM2000 originated in Australia as a result of open-pollination of likely parents Williams and Packhams. It is described as having medium vigour compared to D6. There is no experimental data regarding precocity, productivity or yield efficiency in the literature. This rootstock is included in the APFIP pear rootstock trial and has demonstrated reduced vigour compared to D6 with both Williams and Packhams scions. Current data on yield efficiencies can be found by visiting the APFIP website.

Figure 2: Williams on BM2000 in its 5th leaf at the APFIP pear rootstock trial site in the Goulburn Valley. Central leader system with plant spacing of 4.5m x 1.4m (1,585 trees/ha)

Quince Rootstocks

Almost all quince rootstocks are clonal and they have been used for pear production for many years, particularly in Europe. The most commonly used are:

BA29
Quince A
Quince Sydo
Quince Adams
Quince C

There have been many evaluations carried out with quince rootstocks. Whilst there is often some variation in results between sites and scion cultivars, generally BA29 is considered the most vigorous followed by Quince A and Quince Sydo (both approximately 75% of seedling) and then Quince Adams. Quince C is the least vigorous at approximately 60% of seedling. BA29 is now commonly used in New Zealand for densities of 600 – 1,000 trees/ha.

Quince C and Quince Adams have the highest yield efficiency compared to BA29, Quince A and Sydo (which are all similar).

Figure 3: Conference nursery trees in Belgium. On the left trees are grafted onto Quince C and the right is Quince A.

In more recent years three other promising quince clones have emerged – Quince EMH (developed at East Malling), C132 (a selection from the Caucasus region of Russia) and Eline® (a Romanian selection sourced from Fleuren Nurseries in the Netherlands). These rootstocks are generally considered to perform similar to Quince C in terms of vigour control and yield efficiency. However in some trials they have exhibited traits that may make them more attractive than Quince C, e.g.improved fruit size (EMH and C132) and reduced russetting (Eline®) .

Management challenges with Quince Rootstocks

Quince rootstocks provide good vigour control, but there are still key management challenges associated with their use. One major issue is the incompatibility of quince with many important European pear scion cultivars such as Williams, Beurre Bosc and Packhams. This can be overcome with the use of interstems of compatible cultivars such as Beurre Hardy or Comice.

Quince rootstocks are also susceptible to lime induced chlorosis, which is associated with alkaline soils (high pH). Generally soils high in limestone are prone to alkalinity. The more vigorous quince rootstocks (such as BA29) or *Pyrus* rootstocks are preferred in these soils.

Limited winter hardiness is also an issue with quince rootstocks, and this has limited their use in areas that suffer severe winters, such as the US Pacific North West and parts of Eastern Europe. This should not be a major issue in Australia's pear production regions.

The biggest challenge Australian growers may face with quince rootstocks is their susceptibility to drought stress. This is potentially more serious on the less vigorous Quince C and Adams. If quince is to be adopted in Australia it is important that growers closely monitor tree performance and ensure optimal irrigation management.

Fox Series

Fox 11 and Fox 16 are two recent rootstocks from the Fox series from Italy. They have not been tested in Australia. Fox 11 has vigour similar to BA29 and is recommended for tree densities between 2,000-2,500 trees/ha. It also has good compatibility and tolerates high alkalinity. Fox 16 imparts vigour that is slightly greater than BA29 and has drought tolerance. Fox 16 is less tolerant of high soil alkalinity than Fox 11.

A small number of DCA Fox 11 were planted in the APFIP rootstock trial site in 2009, but as they are yet to be commercially available they have not been included in the rootstock evaluations.

Availability in Australia

At present the most widely available rootstock for pear production is D6. It is expected that Quince A, BM2000 and BP1 should be more readily available in the coming years.

The APFIP® pear rootstock trial is currently the only source of rootstock performance data under Australian conditions. Trail results can be found by visiting the APFIP® website.

The Pear Field Laboratory Rootstock Trials

Innovations in pear production practices in Australia are being showcased by the 'Profitable Pears' project and the 'Pear Field Laboratory' at DEPI Tatura in a series of experiments that aim to determine management practices that optimise precocity and yield of new blush pear cultivars. The performance of three new red blushed pears on six different rootstocks is being evaluated in a rootstock experiment: on D6, D6 with a Nijisseiki interstem, BP1, BM2000, and Quince A and Quince C with Beurre Hardy interstems. All trees are trained to a four leader, Open Tatura trellis system. The primary aim of this experiment is to determine which rootstocks are most appropriate for use with each cultivar, based on tree growth, precocity and yield. A secondary aim is to examine the effects of common pome fruit viruses on productivity of pears.

Previous testing has revealed the presence of apple stem grooving virus in some Asian pear material in Australia, including the Nijisseiki material to be used in this project. This virus is considered undesirable in apple trees and is associated with reduced yields. However, it has been suggested that impacts are less severe in pears and that the presence of such viruses may help control vegetative vigour. A comparison of the D6 treatment with the D6-Nijisseiki treatment is insufficient to determine the effects of virus as the presence of an interstem can impact tree attributes. Consequently, a seventh treatment, where trees on D6 rootstock are virus infected by temporary budding of Nijisseiki material, will be imposed. This will enable the effects and interactions of interstem and virus to be untangled.

Further information

These Australian and international sites may be useful for growers. However they are intended as an information source only. Any specific chemical or other control recommendations may be outdated or irrelevant for Australian conditions and growers should seek local advice.

Australian Resources

Rootstock characteristics

Mark Hankin APFIP results 2013: APFIP Pear RS Trial Report 2013.doc

Grills, A. (2009) Intensive Pear Production in Australia: Why we need more rootstocks? Pdf

Pear rootstocks – New South Wales AgFact.H4.1.15 March 2003: http://www.dpi.nsw.gov.au/agriculture/horticulture/pomes/pear-rootstock

Australian Pome Fruit Improvement Program® Ltd (APFIP) – pear rootstock trial data from the Goulburn Valley.

Accessing rootstocks

Growers should liaise with their nurseries about accessing rootstocks for intensive pear production.

Australian Pome Fruit Improvement Program may also provide some guidance on rootstock availability.

References (Note full access may incur a fee)

Robinson, T.L. (2008) Performance of Pear and Quince Rootstocks with Three Cultivars in Four High Density Training Systems in the Northeastern United States. Acta Horticulturae 800: 793 – 801.

Francescatto, P., Pazzin, D., Gazolla Nero A., Fachinello J., Giacobbo C. (2010) Evaluation of Graft Compatibility between Quince Rootstocks and Pear Scions. Acta Horticulturae 872: 253 – 259.

Musacchi, S. Ancarini, V., Grandi, M., Sansavini S. (2008) Comparative Field Performance of cvs. Sensation Red Bartlett and Cascade Grafted to Six Quince and Pear Clonal Seedling Rootstocks. Acta Horticulturae 596: 385 – 388.

North M. & Cook N. (2008) Effect of Six Rootstocks on 'Forelle' Pear Tree Growth, Production, Fruit Quality and Leaf Mineral Content. Acta Horticulturae 772: 97 – 103.

Maas, F. (2006) Evaluation of Pyrus and Quince Rootstocks for High Density Pear Orchards. Scientific Works of the Lithuanian Institute of Horticulture and Lithuanian University of Agriculture 25(3). 13 – 26

Mielke, E.A. and Smith, L. (2002) Evaluation of the Horner rootstocks. Acta Horticulturae 596: 325 – 330.

Mielke, E.A. and Sugar, D. (2004) Initial Seven-year Evaluation of Thirteen Horner Pear Rootstocks. Acta Horticulturae 658: 513 –517.

Johnson D., Evans K., Spencer, J., Webster, T. and Adam, S. (2005) Orchard Comparisons of New Quince and *Pyrus* Rootstock Clones. Acta Horticultuae 671: 201– 207

Simard M.H. and Michelesi J.C. (2002) 'Pyriam': a New Pear Rootstock. Acta Horticulturae 596: 351 – 355.